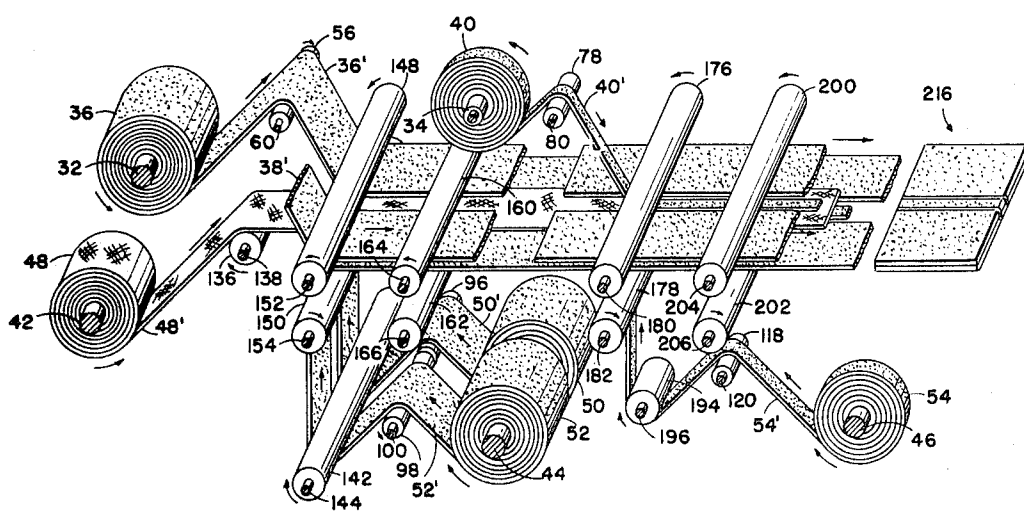


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[21] Appl. No. **805,057**
[22] Filed **Nov. 29, 1968**
Division of Ser. No. 446,820,
Apr. 9, 1965, Patent No. 3,476,406
[45] Patented **Sept. 21, 1971**
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[56] **References Cited**
UNITED STATES PATENTS
2,350,336 6/1944 Bauer et al. 117/155 L UX
3,206,349 9/1965 Boyle 156/554 X
3,318,751 5/1967 Ungerer et al. 156/510 X
3,402,068 9/1968 Wilkins 117/155 L UX
FOREIGN PATENTS
497,788 12/1938 Great Britain..... 156/554
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[54] **APPARATUS AND METHOD FOR MAKING AND COATING BOOK COVER BOARD STRUCTURES**
16 Claims, 10 Drawing Figs.
[52] U.S. Cl..... **156/269,**
156/554, 156/516
[51] Int. Cl..... **B32b 31/18,**
B32b 31/20
[50] Field of Search..... **156/269,**
510, 516, 554; 117/155 L

ABSTRACT: A book cover board construction is provided wherein a multilayer spine board and a pair of multilayer leaf boards are hinged together by a strip of material between the respective panels and the entire structure encapsulated by an adherent coating material. The coating material is applied in fluid form so as to cover the panels in a thin coating. The coating can be applied by curtain coating or by spraying.



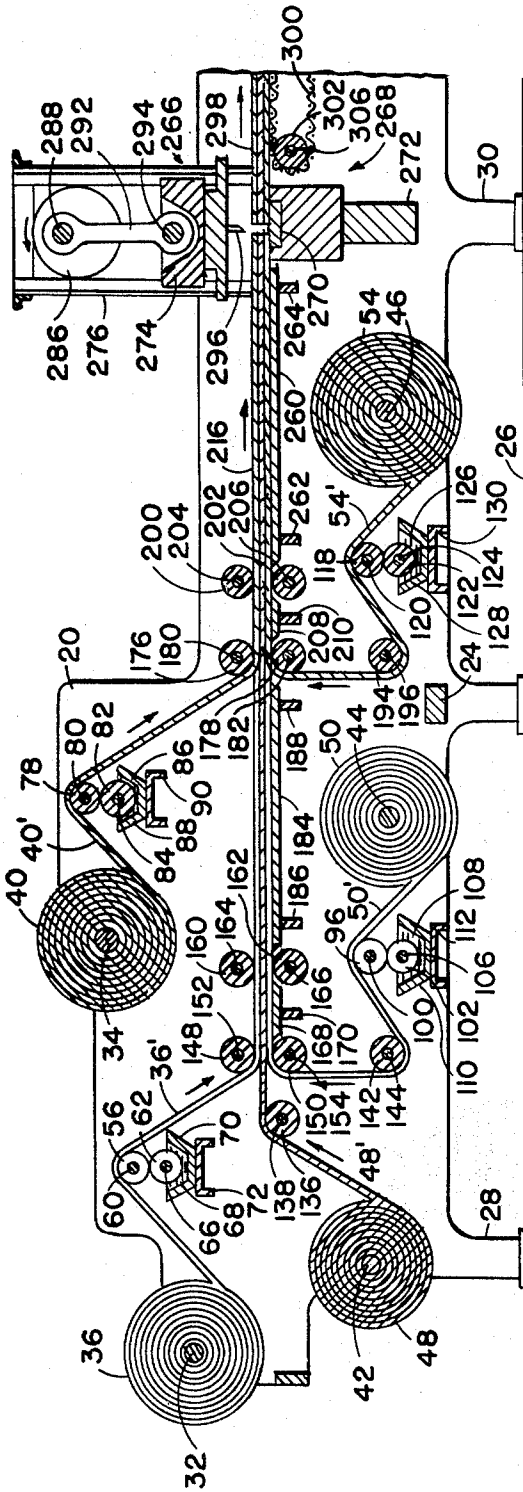


FIG. 1

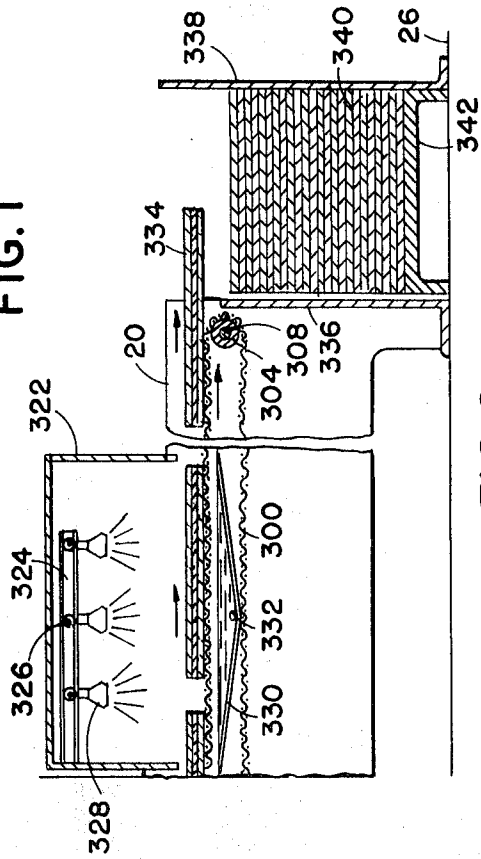


FIG. 2

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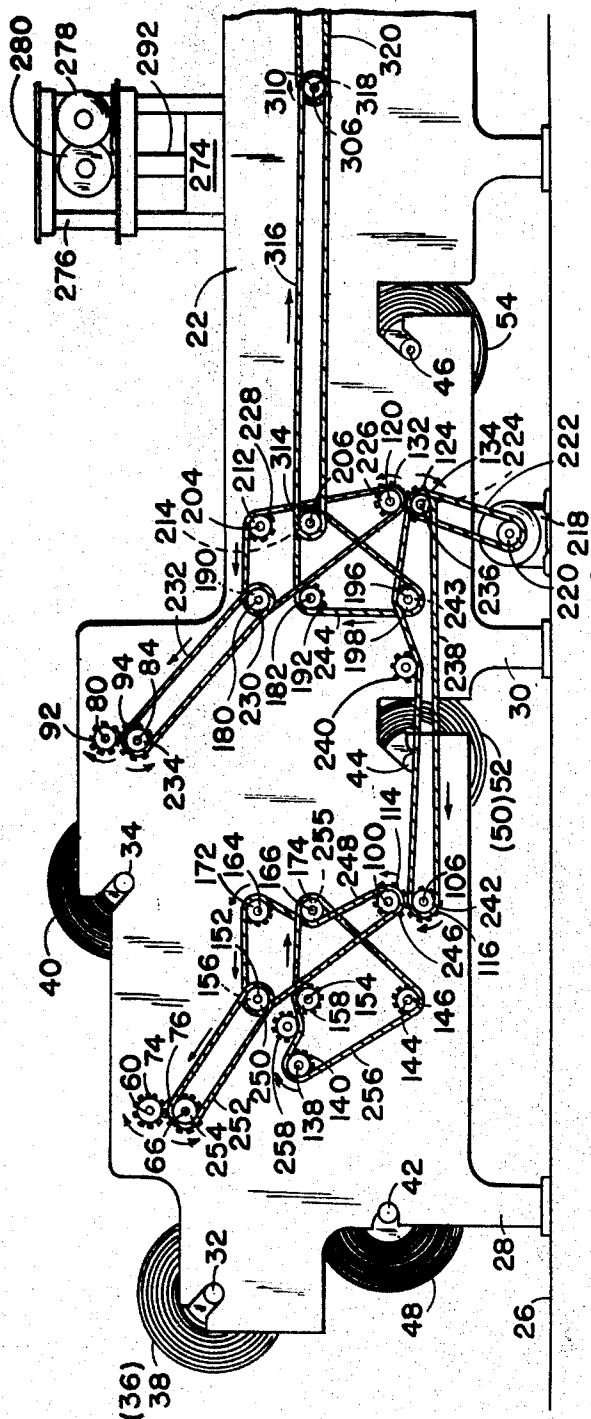


FIG. 3

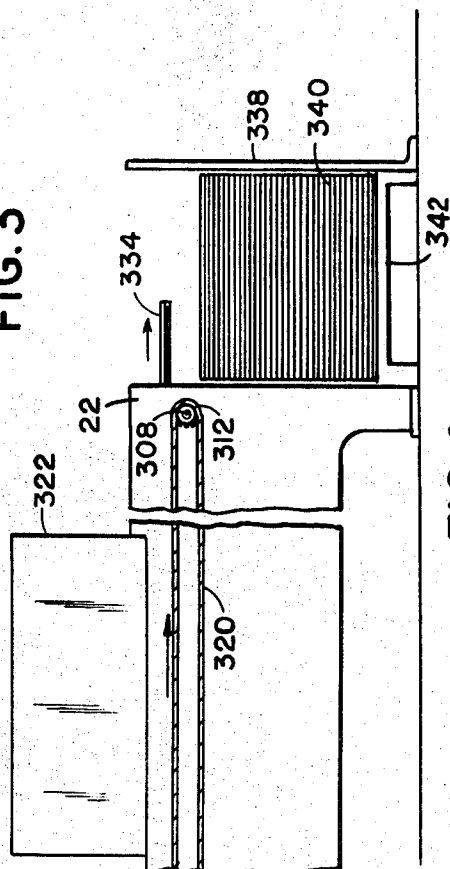
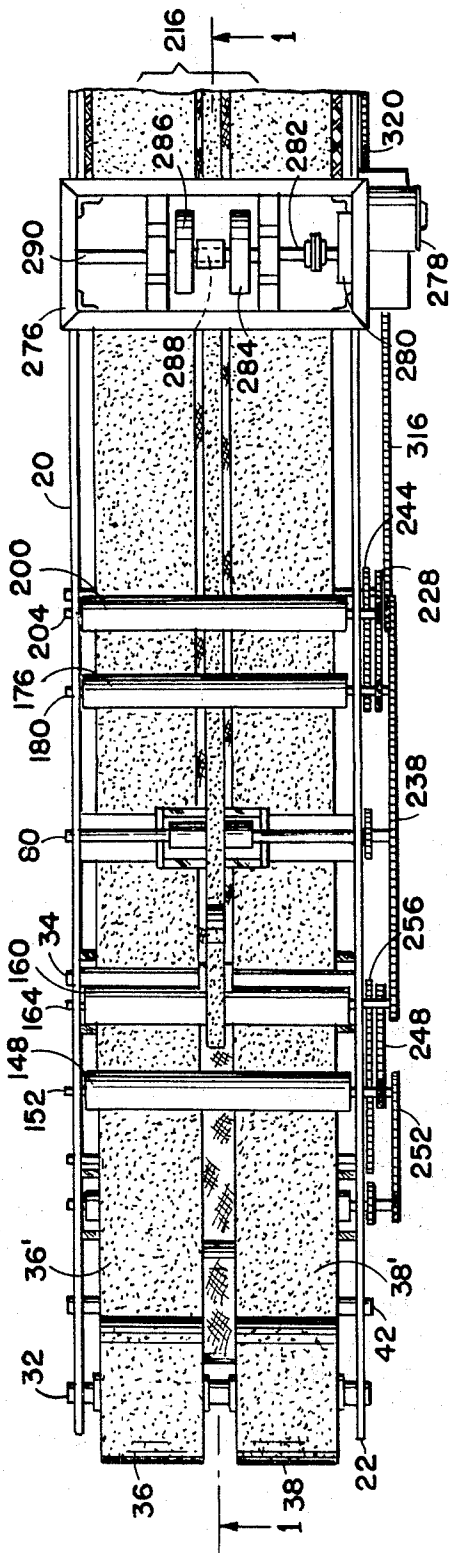
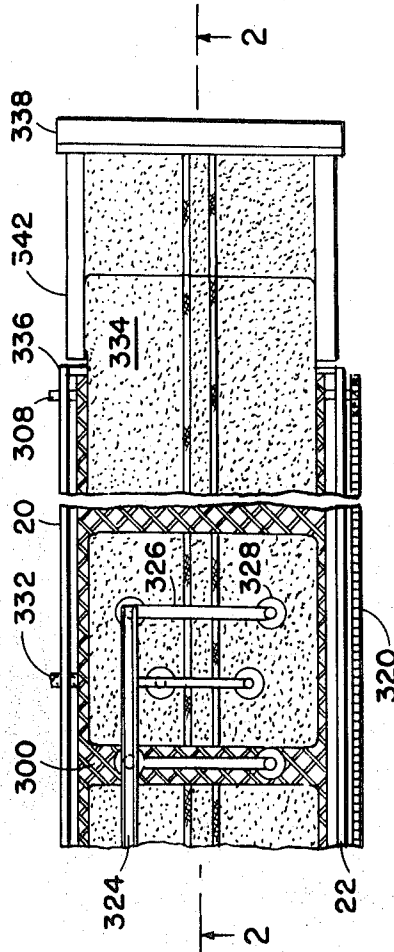


FIG. 4

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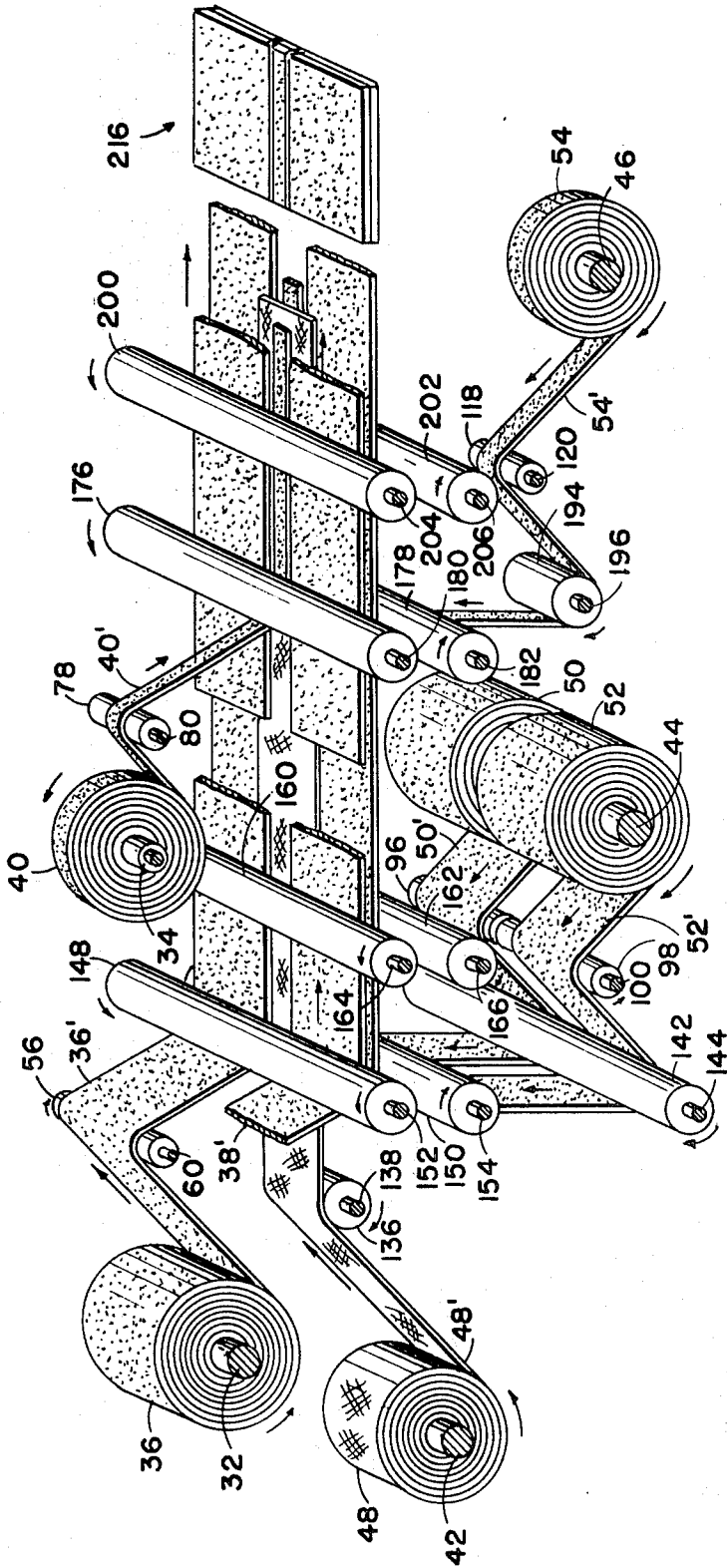


FIG. 7

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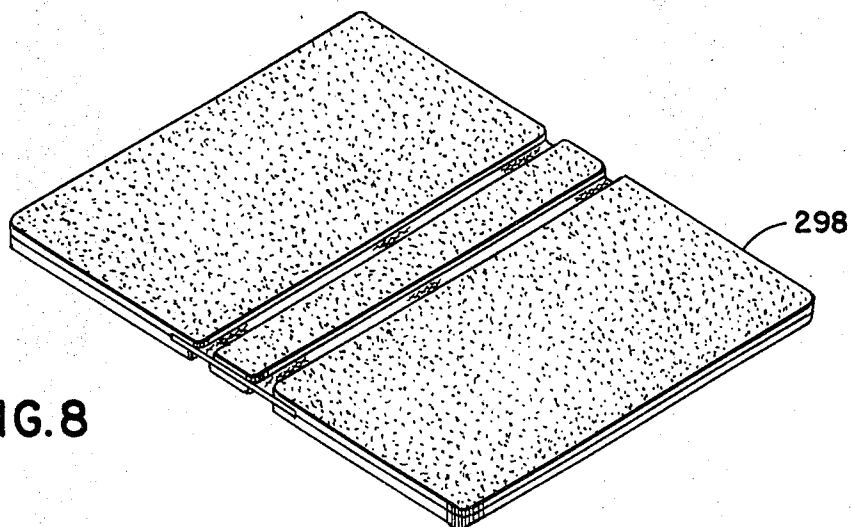


FIG. 8

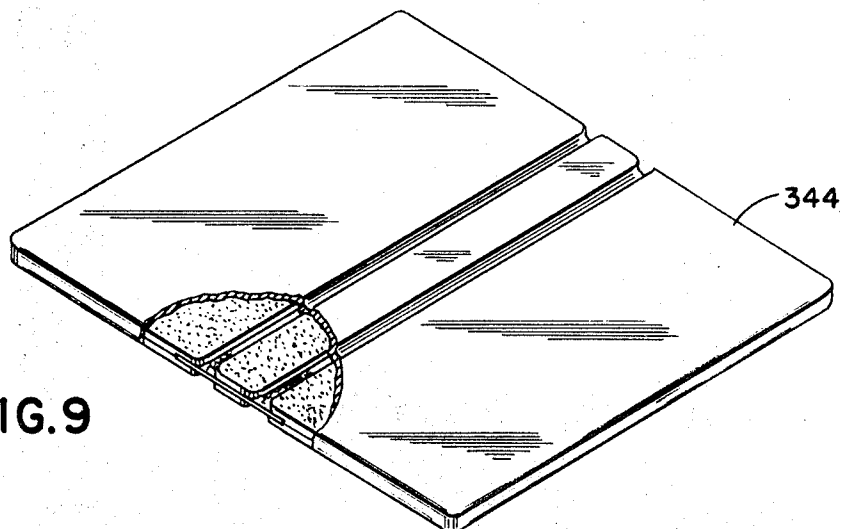


FIG. 9

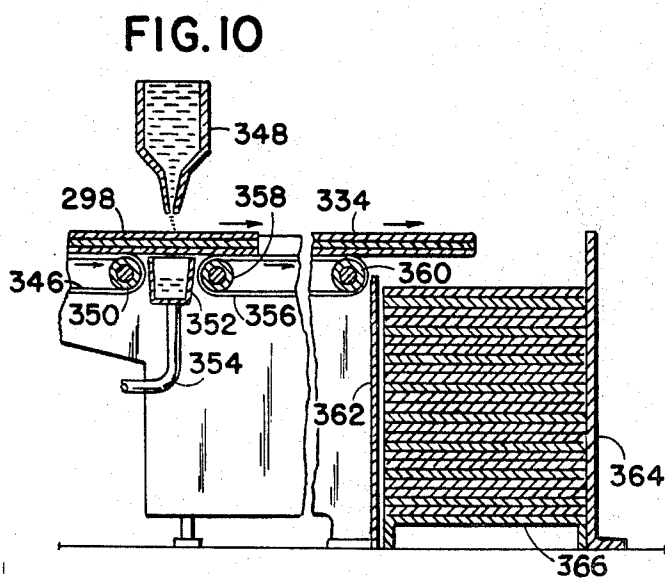


FIG. 10

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APPARATUS AND METHOD FOR MAKING AND COATING BOOK COVER BOARD STRUCTURES

This is a division of application Ser. No. 446,820, filed Apr. 9, 1965 now U.S. Pat. No. 3,476,406.

This invention relates to book cover boards, looseleaf cover boards, ring binder cover boards, and album or catalog cover boards and to an apparatus and method for making the same. It relates particularly to book cover board structures having leaf boards and spine boards of multilayer construction and to an apparatus and method for making the same. It relates more particularly to book cover board structures having leaf boards hinged in spaced relation to their spine boards and to an apparatus and method for making the same. It relates still more particularly to book cover board structures of the kind just described in which hinge elements joining multilayer leaf board assemblies with multilayer spine board assemblies are interposed between upper and lower layers of each of these assemblies, and to an apparatus and method for making the same. It relates even still more particularly to book cover board structures of the kind described which are completely and continuously coated inside and outside with an adherent material and to an apparatus and method for making and coating the same.

It is an object of this invention to provide a book cover board structure comprising two leaf board portions hinged in relation to a spine board portion and the whole structure encapsulated by an adherent coating material applied to it in fluid form.

It is another object of this invention to provide a book cover board structure of the kind described in the first-recited object in which the coating material is an air-drying lacquer applied by spraying.

It is another object of this invention to provide a book cover board structure of the kind described in the first-recited object in which the coating material is a thermosetting plastic applied by streaming or curtain coating.

It is another object of this invention to provide a book cover board structure of the kind described in the first-recited object in which the two leaf board portions are hinged in spaced relation to the spine board portion.

It is another object of this invention to provide a book cover board structure of the kind described in the foregoing object in which the two leaf board portions are joined to the spine board portion by a strip of hinge material of such nature that both inside and outside coatings of a lacquer or a molten plastic applied by spraying or curtain coating will adhere to it as well as to the leaf and spine board portions. This object may be achieved by making the hinge strip of a strong, closely woven cloth or other strong yet flexible material such as vinyl film or plastic-coated cloth.

It is another object of this invention to provide a book cover board structure of the kind described in the foregoing object in which the leaf board portions and the spine board portion are each of multilayer construction with the strip of hinge material passing between and being bonded to upper and lower layers of the spine board portions and also passing at least part way between and being bonded to upper and lower layers of both the first and second leaf board portions.

It is another object of this invention to provide a book cover board structure-making apparatus which is adapted to be fed with four continuous streams of leaf board material running in pairs to form upper and lower layers of successive individual leaf board assemblies with the pairs being in spaced relation to each other between adjacent edge regions; to be fed further with two continuous streams of spine board material running as a pair in equally spaced relation between the pairs of streams of leaf board material to form upper and lower layers of successive individual spine board assemblies; to be fed further with a continuous stream of hinge material to run in interposed relation between the upper and lower streams of spine board material and also to extend at least part way in between the upper and lower streams of each pair of streams of leaf board material; to apply adhesive material onto the surfaces of all streams of leaf board and spine board material in

facing relation either with each other or with the surfaces of the stream of hinge material; to press the facing end adhesively coated surfaces of the streams of leaf board and spine board material together with each other and with the streams of hinge material to generate a continuous stream of bonded book cover board structure material, and to sever this stream into successive individual book cover board structures.

It is another object of this invention to provide a book cover board structure making apparatus of the kind described in the foregoing object which is further adapted to apply complete coatings or films of lacquer or plastic material in fluid form to successive individual cover board structures by spray-coating or curtain-coating equipment, this material being of a nature to set very rapidly and form a continuous, stable, and non-tacky coating around each individual book cover board structure, but one which is adequately flexible at the structure's hinge regions.

It is another object of this invention to provide a book cover board structure-making method including the steps of generating two pairs of superposed upper and lower streams of leaf board material and feeding these pairs of streams continuously in spaced and essentially parallel coplanar relation; generating a pair of superposed upper and lower streams of spine board material and feeding this pair of streams continuously between the pairs of streams of leaf board material in essentially equally spaced and parallel coplanar relation with the same; generating a continuous stream of hinge material and feeding this stream continuously between the upper and lower streams of spine board material and also part way in between the upper and lower streams of each pair of streams of leaf board material in essentially parallel relation with the same; applying adhesive material onto the surfaces of all streams of leaf board and spine board material in facing relation either with each other or with the surfaces of the stream of hinge material; pressing the facing and adhesively coated surfaces of the streams of leaf board and spine board material together with each other and with the stream of hinge material to generate a continuous stream of bonded book cover board structure material, and severing this stream into successive individual book cover board structures.

It is another object of this invention to provide a book cover board structure making method of the kind described in the foregoing object which further includes the step of applying complete coatings or films of lacquer or plastic material in fluid form to successive individual cover board structures by spray coating or curtain coating, this material being of a nature to set up rapidly and seal on and around each cover board structure for the production of a coated book cover board structure.

The nature and substance of this invention as well as its objects and advantages will be more clearly perceived and fully understood by referring to the following description and claims taken in connection with the accompanying drawings in which:

FIG. 1 represents a view in longitudinal sectional elevation of the book cover board structure-making apparatus of this invention from its loading end up to and somewhat beyond the mechanism for severing successive individual, uncoated book cover board structures taken along line 1—1 in FIG. 5 looking in the direction of the arrows;

FIG. 2 represents a view in longitudinal sectional elevation of the book cover board structure-making apparatus of this invention in a continuation of the view of FIG. 1 through the discharge end of the apparatus taken along line 2—2 in FIG. 6 looking in the direction of the arrows, and particularly showing a fluid-spraying arrangement for applying lacquer coatings to successive individual book cover board structures;

FIG. 3 represents an exterior view in longitudinal elevation of the portion of the book cover board structure-making apparatus of this invention shown in FIG. 1;

FIG. 4 represents an exterior view in longitudinal elevation of the portion of the book cover board structure making apparatus of this invention shown in FIG. 2;

FIG. 5 represents a plan view of the portion of the book cover board structure-making apparatus of this invention shown in FIG. 3;

FIG. 6 represents a plan view of the portion of the book cover board structure making apparatus of this invention shown in FIG. 4 with no hood on the lacquer-coating spray equipment;

FIG. 7 represents an isometric view of the streams of leaf board, spine board, and hinge material passing through the apparatus of this invention from the supply or loading rolls of these materials up to just in front of the mechanism for severing successive individual, uncoated book cover board structures;

FIG. 8 represents an isometric view of a book cover board structure made by the apparatus and method of this invention after this structure has been severed from the stream of bonded book cover board structure material but before the application of coating material to it;

FIG. 9 represents an isometric view of a coated book cover board structure made by the apparatus and method of this invention, part of the coating being broken away, and

FIG. 10 represents a view in longitudinal sectional elevation taken on a plane corresponding to that of FIG. 2 showing an alternate continuation of the view of FIG. 1 through the discharge end of the apparatus of this invention, and particularly showing a fluid-streaming or curtain-coating arrangement for applying plastic coatings to successive individual book cover board structures.

Referring now to the drawings in detail, especially to FIGS. 1, 3, 5 and 7 thereof, the apparatus of the invention comprises two sideplate assemblies 20 and 22 which are maintained in spaced and substantially parallel relation by means of a plurality of crossbars or crosspieces such as crosspiece 24, and which are supported above the level of floor 26 by means of a plurality of leg members such as leg members 28 and 30. In their upper edges at and near their left-hand ends, sideplates 20 and 22 are notched to provide bearing and retaining surfaces for shafts 32 and 34. Shaft 32 extends through and beyond spaced paperboard rolls 36 and 38 from which are ultimately cut the upper layers of the leaf board portions of the cover board structures made by the illustrated apparatus. Shaft 34 extends through and beyond paperboard roll 40 from which are ultimately cut the upper layers of the spine board portions of the cover board structures made by the illustrated apparatus.

In their left-hand ends near their lower edges, sideplates 20 and 22 are notched to provide bearing and retaining surfaces for shaft 42, and in their lower edges fairly near their left-hand ends the sideplates are notched to receive rotatable shafts 44 and 46. Shaft 42 extends through and beyond hinge material roll 48 from which are ultimately cut the hinge material portions of the cover board structures made by the illustrated apparatus. Shaft 44 extends through and beyond spaced paperboard rolls 50 and 52 from which are ultimately cut the lower layers of the leaf board portions of the cover board structures made by the illustrated apparatus. Shaft 46 extends through and beyond paperboard roll 54 from which are ultimately cut the lower layers of the spine board portions of the cover board structures made by the illustrated apparatus.

The paperboard in strip form which is wound into rolls 36, 38, 40, 50, 52, and 54 is a material which is suitable to form both the spine and the leaves of a book cover. It has a thickness usually lying in the range of 0.030 to 0.060 in. leaving it sufficient flexibility for winding. Usually although not necessarily, the paperboard materials wound into rolls 36, 38, 40, 50, 52, and 54 will be of essentially identical thickness for a given production run of cover board assemblies on the illustrated apparatus. The material in strip form wound into roll 48 whereby the leaf and spine board portions of a cover board structure made according to the present invention are joined may, as aforesaid, be a strong, closely woven cloth or other strong yet flexible material such as vinyl film or plastic-coated cloth. It will generally be much thinner than the leaf board and spine board material.

Paperboard strips wound into rolls 36, 38, 50, and 52 are of essentially identical width as are the paperboard strips wound into rolls 40 and 54. By means of suitably placed collars on their supporting shafts, rolls 36 and 50 are essentially identically spaced between sideplates 20 and 22 so that a strip of paperboard material unwound from roll 36 and extended down the length of the illustrated apparatus will lie directly over a strip unwound from roll 50. A similar situation obtains with rolls 38 and 52 as a pair of rolls and also with the rolls 40 and 54. The last-mentioned two rolls are further so positioned transversely as a pair that strips of material unwound from them will lie, in side-to-side spacing, midway between strips unwound from rolls 36 and 50 on one side and strips unwound from rolls 38 and 52 on the other side. Hinge material roll 48 is so positioned between sideplates 20 and 22 that a strip of material unwound from it will be centered transversely with respect to paperboard strips unwound from spine board material rolls 40 and 54.

The strips or streams of paperboard material 36' and 38' unwound from rolls 36 and 38 are led first of all over upper glue or adhesive rolls 56 and 58 respectively which are both carried on a shaft 60 mounted rotatably in and extending through sideplate assemblies 20 and 22. Upper glue rolls 56 and 58 run in conjunction with lower glue rolls 62 and 64 (hidden) respectively which are both carried on shaft 66 mounted rotatably in and extending through sideplates 20 and 22. Lower glue rolls 62 and 64 are partially immersed in a body of liquid glue or adhesive 68 of any suitable kind contained in a trough 70 which is supported between sideplates 20 and 22 on a bracket 72. On their ends extending through sideplate 22, shaft 60 carries a gear 74 and shaft 66 carries a gear 76 with these two gears being in mesh. Shafts 60 and 66 and the glue rolls which they carry thus are arranged to rotate or be rotated simultaneously and in opposite directions.

The strip or stream of paperboard material 40' unwound from roll 40 is led first of all over upper glue roll 78 which is carried on shaft 80 mounted rotatably in and extending through sideplates 20 and 22. Upper glue roll 78 runs in conjunction with lower glue roll 82 which is carried on shaft 84 mounted rotatably in and extending through sideplates 20 and 22. Lower glue roll 84 is partially immersed in a body of liquid glue or adhesive 86 contained in a trough 88 which is supported between sideplates 20 and 22 on a bracket 90. On their ends extending through sideplate 22, shaft 80 carries a gear 92 and shaft 84 carries a gear 94 with these two gears being in mesh. Shafts 80 and 84 and the glue rolls which they carry thus are arranged to rotate or be rotated simultaneously and in opposite directions.

The strips or streams of paperboard material 50' and 52' unwound from rolls 50 and 52 are led first of all over upper glue rolls 96 and 98 respectively which are both carried on shaft 100 mounted rotatably in and extending through sideplates 20 and 22. Upper glue rolls 96 and 98 run in conjunction with lower glue rolls 102 and 104 (hidden) respectively which are both carried on shaft 106 mounted rotatably in and extending through sideplates 20 and 22. Lower glue rolls 102 and 104 are partially immersed in a body of liquid glue 108 contained in a trough 110 which is supported between sideplates 20 and 22 on a bracket 112. On their ends extending through sideplate 22, shaft 100 carries a gear 114 and shaft 106 carries a gear 116 with these two gears being in mesh. Shafts 100 and 106 and the glue rolls which they carry thus are arranged to rotate or be rotated simultaneously and in opposite directions.

The strip or stream of paperboard material 54' unwound from roll 54 is led first of all over upper glue roll 118 which is carried on shaft 120 mounted rotatably in and extending through sideplates 20 and 22. Upper glue roll 118 runs in conjunction with lower glue roll 122 which is carried on shaft 124 mounted rotatably in and extending through sideplates 20 and 22. Lower glue roll 122 is partially immersed in a body of liquid adhesive 126 contained in a trough 128 which is supported between sideplates 20 and 22 on a bracket 130. On

their ends extending through sideplate 22, shaft 120 carries a gear 132 and shaft 124 carries a gear 134 with these two gears being in mesh. Shafts 120 and 124 and the glue rolls which they carry thus are arranged to rotate or be rotated simultaneously and in opposite direction.

The action of glue rolls 118 and 122 is typical of that of the rolls of each set or pair of rolls. As glue rolls 118 and 122 are rotated, lower roll 122 picks up a layer of liquid adhesive material from the body of glue 126 within trough 128. The rolls have at least a slight separation which is desirably subject to some adjustment through vertically shiftable mountings of the shaft of one of the rolls in sideplates 20 and 22. At least some of the layer of glue or adhesive on lower roll 122 is transferred onto upper roll 118 in the course of the rolls' rotation. The greater the separation of the glue rolls, up to a point, the greater is the amount of glue transferred from the lower onto the upper roll. As paperboard strip 54' passes over upper glue roll 118 there is a further transfer of glue from this roll onto the underside of this strip.

The stream or strip of hinge material 48' unwound from roll 48 is led first of all over conveyor roll 136 which is carried on shaft 138 mounted rotatably in and extending through sideplates 20 and 22. On its end extending through sideplates 22, shaft 138 carries a sprocket wheel 140 through which drive is applied to the shaft as explained hereinafter. The stream or strips of leaf board material 50' and 52' after leaving glue rolls 96 and 98 are led under conveyor roll 142 which is carried on shaft 144 mounted rotatably in and extending through sideplates 20 and 22. As may be seen, of course, contact between roll 142 and strips 50' and 52' is made on the sides of the strips which have not been in contact with glue rolls 96 and 98. On its end extending through sideplate 22, shaft 144 carries a sprocket wheel 146 through which drive is applied to the shaft as explained hereinafter.

In their continued flow, leaf board strips 36', 38', 50', and 52' and hinge material strip 48' all converge toward and enter between upper and lower press rolls 148 and 150 constituting a first pair of press rolls which are carried on shafts 152 and 154 respectively. These shafts are mounted rotatably in and extend through sideplates 20 and 22. The adhesive-carrying surfaces of leaf board strips 36' and 50' are pressed into contact with each other and with the upper and lower surfaces of one edge region of hinge material strip 48'. Similarly, the adhesive-carrying surfaces of leaf board strips 38' and 52' are pressed into contact with each other and with the upper and lower surfaces of the other edge region of the hinge material strip. On their ends extending through sideplate 22, shafts 152 and 154 carry sprocket wheels 156 (hidden) and 158 respectively through which drive is applied to these shafts as explained hereinafter.

After passing between press rolls 148 and 150, the at least incipiently bonded strips 36', 38', 50', 52', and 48' flow toward and enter between the rolls of another or second pair of upper and lower press rolls 160 and 162 which are carried on shafts 164 and 166 respectively. These shafts are mounted rotatably in and extend through sideplates 20 and 22. Between the first and second pairs of press rolls the strips slide along a smooth platform 168 which is supported between sideplates 20 and 22 on crosstie 170. On their ends extending through sideplate 22, shafts 164 and 166 carry sprocket wheels 172 and 174 respectively through which drive is applied to these shafts as explained hereinafter. Press rolls 148 and 150, and also 160 and 162, are set sufficiently closely together and have sufficiently roughened or otherwise drag-inducing surfaces that they can pull paperboard or leaf board strips or streams steadily off of rolls 36, 38, 50, 52 with vertically opposing strips 36' and 50' on one side and 38' and 52' on the other side pressing tightly enough on the edge regions of hinge material strip 48' that this strip is drawn steadily off of roll 48.

After passing between press rolls 160 and 162, the bonded strips 36', 38', 50', 52', and 48' flow toward and enter between the rolls of still another or third pair of upper and lower press rolls 176 and 178 which are carried on shafts 180

and 182 respectively. These shafts are mounted rotatably in and extend through sideplates 20 and 22. Between the second and third pairs of press rolls the strips slide along a smooth platform 184 which is supported between sideplates 20 and 22 on crossties 186 and 188. On their ends extending through sideplate 22, shafts 180 and 182 carry sprocket wheels 190 (hidden) and 192 respectively through which drive is applied to these shafts as explained hereinafter.

The stream or strip of spine board material 54' after leaving upper glue roll 118 is led under conveyor roll 194 which is carried on shaft 196 mounted rotatably in and extending through sideplates 20 and 22. As may be seen, of course, contact between roll 194 and strip 54' is made on the side of the strip which has not been in contact with glue roll 118. On its end extending through sideplate 22, shaft 196 carries a sprocket wheel 198 through which drive is applied to this shaft as explained hereinafter.

In their continued flow, spine board strips 40' and 54' to one side of each of which adhesive material has been applied both converge toward and enter between press rolls 176 and 178. On their adhesive-carrying sides, strips 40' and 54' come into contact with and are pressed essentially centrally against the upper and lower surfaces respectively of hinge material strip 48'. The spine board strips are at least somewhat narrower than the clear width of the hinge material strip between the pairs of adhered leaf board strips, and thus a narrow clear area of the hinge material strip is left on either side of the pair of spine board strips between this pair and the pairs of adhered leaf board strips.

It is a feature of the present invention that no glue or adhesive material is applied to hinge material strip 48' directly from a glue roll, but only from leaf board and spine board strips pressed against the hinge material strip. In principle, therefore, there should be no glue on the aforescribed narrow clear areas of the hinge material strip. This condition will be achieved very closely in practice if reasonable care be used in regulating the rate of glue transfer onto the leaf board and spine board strips as they pass over the several upper glue roll so that there will be no significant sidewise squeezing of glue when these strips are pressed against hinge material strip 48'. The areas left clear on strip 48' are the ones in which hinging or flexing takes place later on as these areas occur segmentally in individual completed cover board structures, and it is desirable that they not be weakened, embrittled, or deteriorated in any way by soaked in and dried glue. Likewise, these areas should be free of glue which might prevent later adhesion of lacquer or plastic coating material to the hinge material.

After passing through press rolls 176 and 178 the at least incipiently bonded strips 36', 38', 50', 52', 48', 40', and 54' flow toward and enter between the rolls of a fourth and final pair of upper and lower press rolls 200 and 202 which are carried on shafts 204 and 206 respectively. These shafts are mounted rotatably in and extend through sideplates 20 and 22. Between the third and fourth pairs of press rolls the strips slide along a smooth platform 208 which is supported between sideplates 20 and 22 on crosstie 210. On their ends extending through sideplate 22, shafts 204 and 206 carry sprocket wheels 212 and 214 (hidden) respectively through which drive is applied to these shafts as explained hereinafter.

Press rolls 176 and 178, and also 200 and 202, are set sufficiently closely together and have sufficiently roughened or otherwise drag-inducing surfaces that they can take up paperboard strips or streams 36', 38', 50', and 52', with included hinge material strip 48', steadily as these strips are fed to them from press rolls 160 and 162, and also pull spine board strips or streams 40' and 54' steadily off of rolls 40 and 54. By the actions of the several pairs of press rolls, the leaf board strips are crushed along their inner edges sufficiently locally and the spine boards strips are crushed sufficiently generally in way of the hinge material strip that the finished strip or stream of cover board structure material 216 leaving rolls 200 and 202 is of essentially uniform thickness throughout its multilayer leaf board and spine board sections.

Mounted on floor 26 more or less below sideplate 22 is an electric motor 218. On its output shaft this motor carries a sheave 220 around which passes at least one V-belt 222. This belt also passes around a sheave 224 (hidden) on shaft 124 of lower glue roll 122. This sheave is the input point for driving power for all of the operating equipment of the apparatus of the present invention as so far described. Rotation of shaft 124 with attendant rotation of lower glue roll 122 causes rotation of shaft 120 and upper glue roll 118 through the meshing of gears 132 and 134.

Besides gear 132, shaft 120 carries a sprocket wheel 226. A sprocket chain 228 passes around this sprocket wheel and also around sprocket wheel 190 on shaft 180 of press roll 176 and sprocket wheel 212 on shaft 204 of press roll 200. Rotation of shaft 120 with attendant rotation of upper glue roll 118 thus causes rotation of shafts 180 and 204 with attendant rotation of press rolls 176 and 200.

Besides sprocket wheel 190, shaft 180 carries a sprocket wheel 230. A sprocket chain 232 passes around this sprocket wheel and also around sprocket wheel 234 on shaft 84 of lower glue roll 82. Rotation of shaft 180 thus causes rotation of shaft 84, and rotation of shaft 84 with attendant rotation of lower glue roll 82 causes rotation of shaft 80 and upper glue roll 78 through the meshing of gears 92 and 94.

Besides gear 134 and sheave 224, shaft 124 carries a sprocket wheel 236. A sprocket chain 238 passes around this sprocket wheel, over sprocket wheel 198 on shaft 196 of conveyor roll 194, under idler or tensioning sprocket wheel 240 mounted rotatably on a stub shaft extending outwardly from sideplate 22, and also around sprocket wheel 242 on shaft 106 of lower glue rolls 102 and 104. Rotation of shaft 124 thus causes rotation of shafts 196 and 106, and rotation of shaft 106 with attendant rotation of lower glue rolls 102 and 104 causes rotation of shaft 100 and upper glue rolls 96 and 98 through the meshing of gears 114 and 116.

Besides sprocket wheel 198, shaft 194 of conveyor roll 196 carries a sprocket wheel 234 (hidden). A sprocket chain 244 passes around this sprocket wheel, around sprocket wheel 192 on shaft 182 of press roll 178, and also around sprocket wheel 214 on shaft 206 of press roll 202. Rotation of shaft 194 thus causes rotation of shafts 182 and 206 with attendant rotation of press rolls 178 and 202.

Besides gear 114, upper glue roll shaft 100 carries a sprocket wheel 246. A sprocket chain 248 passes around this sprocket wheel, around sprocket wheel 156 on shaft 152 of press roll 148, around sprocket wheel 172 on shaft 164 of press roll 160, and also around sprocket wheel 174 on shaft 166 of press roll 162. Rotation of shaft 100 thus causes rotation of shafts 152, 164, and 166 with attendant rotation of press rolls 148, 160, and 162.

Besides sprocket wheel 156, press roll shaft 152 carries a sprocket wheel 250. A sprocket chain 252 passes around this sprocket wheel and also around sprocket wheel 254 on shaft 66 of lower glue rolls 62 and 64. Rotation of shaft 152 thus causes rotation of shaft 66, and rotation of shaft 66 with attendant rotation of lower glue rolls 62 and 64 causes rotation of shaft 60 and upper glue rolls 56 and 58 through the meshing of gears 74 and 76.

Besides sprocket wheel 174, shaft 166 of press roll 162 carries a sprocket wheel 255 (hidden). A sprocket chain 256 passes around this sprocket wheel, over sprocket wheel 158 on shaft 154 of press roll 150, under idler or tensioning sprocket wheel 258 mounted rotatably on a stub shaft extending outwardly from sideplate 22, around sprocket wheel 140 on shaft 138 of conveyor roll 136, and also around sprocket wheel 146 on shaft 144 of conveyor roll 142. Rotation of shaft 166 thus causes rotation of shafts 154, 138, and 144 with attendant rotation of press roll 150, conveyor roll 136, and conveyor roll 142.

From the foregoing several paragraphs it is to be seen that electric motor 218 provides mechanical power to drive all six glue roll pairs 56 and 62, 58 and 64, 78 and 82, 96 and 102, 98 and 104, and 118 and 122; all four press roll pairs 148 and 150, 160 and 162, 176 and 178, and 200 and 202, and all

three conveyor rolls 136, 142, and 194 so far described. The glue rolls, press rolls, and conveyor rolls preferably all have essentially the same diameter, and the components of the sprocket wheel, sprocket chain, and gear system whereby these various rolls are driven from the point of mechanical power input to the system on shaft 124 are so sized and otherwise arranged that the glue rolls, press rolls, and conveyor rolls are all driven at essentially identical surface speeds.

Upon issuing from between press rolls 200 and 202, the bonded strip or stream of cover board material 216 is moved to the right as seen in FIG. 1 along a smooth platform 260 which is supported between sideplates 20 and 22 on crossties 262 and 264. It then passes between blade and cutting block assemblies 266 and 268. Cutting block assembly 268 including an upper, hardened insert 270 is supported between sideplates 20 and 22 on heavy crosstie 272. Blade assembly 266 is supported from the lower side of piston or ram 274 which is capable of guided, vertical motion within a framework 276 supported on sideplates 20 and 22. Mounted in the upper part of this framework there is an electric motor 278 having suitable gear head speed-reducing means 280 through which it provides immediate drive for a shaft 282 supported rotatably in appropriate bearings. At its inner end, shaft 282 carries a flywheel 284. A second flywheel 286 is connected to flywheel 284 by means of a crankpin 288, and is carried on the inner end of a shaft 290 supported rotatably in appropriate bearings on framework 276. A connecting rod 292 extends from crankpin 288 to wristpin 294 in ram 274.

When motor 278 is running it causes counterclockwise rotation of the flywheels as seen in FIG. 1. Ram 274 moves up and down in framework 276 and blade assembly 266 follows the motion of the ram, alternately moving toward and withdrawing from cutting block assembly 268. Knife edge or cutter blade 296 of blade assembly 266 acting against hardened insert 270 severs successive individual cover board structures 298 off of advancing cover board structure material strip 216. The blade assembly may also, if desired, include cutter elements for rounding the corners of the severed cover board structures. A representative cover board structure 298 is shown isometrically in FIG. 8.

Electric motor 278 which drives blade assembly 266 may be of the variable-speed-kind in order to provide a stroking rate of the blade assembly which is consistent with the average rate of advance of cover board structure material strip 216, set by motor 218, to cut off individual cover board structures 298 of proper length or depth. On the other hand, motor 278 may be a fixed-speed motor and be connected to shaft 282 through a variable-ratio drive mechanism rather than through a gear head speed reducer. Motor 218 may run at a predetermined or reference speed according to which the speed of motor 278 is adjusted to provide steady operation of the illustrated apparatus. Although serving as a speed reference, motor 218 need not be a fixed-speed motor. Indeed, if it uses direct chain and sprocket drives as shown it should be a variable-speed motor so that the illustrated apparatus may be brought up to speed gradually. Alternatively, motor 218 may be a fixed-speed motor having its shaft connected to a variable ratio drive mechanism from which power is transmitted to V-belt 222.

Reference should be had now to FIGS. 2, 4, and 6 as well as to FIGS. 1, 3, and 5 considered in detail already.

As they pass across cutting block assembly 268, successive leading portions of cover board structure material strip 216 about to be severed or cut off as individual cover board structures 298 come part way onto an endless screen or mesh belt 300. This belt, which picks up and conveys the structures 298 after severance, passes around conveyor rolls 302 and 304 which are carried on shafts 306 and 308 respectively. These shafts are mounted rotatably in and extend through sideplates 20 and 22. On their ends extending through sideplate 22, shafts 306 and 308 carry sprocket wheels 310 and 312 respectively through which drive is applied to these shafts as explained hereinafter.

Besides sprocket wheel 214, press roll shaft 206 carries a sprocket wheel 314. A sprocket chain 316 passes around this sprocket wheel and also around sprocket wheel 310 on shaft 306. Rotation of shaft 206 thus causes rotation of shaft 306 with attendant rotation of conveyor roll 302. Besides sprocket wheel 310, conveyor roll shaft 306 carries a sprocket wheel 318 (hidden). A sprocket chain 320 passes around this sprocket wheel and also around sprocket wheel 312 on shaft 308. Rotation of shaft 306 thus causes rotation of shaft 308 with attendant rotation of conveyor roll 304. Rotation of conveyor roll 304 together with conveyor roll 302 causes travel or circulation of mesh belt 300. The surfaces of these conveyor rolls may be cleated or otherwise contoured for engagement with the mesh openings or elements of belt 300 to insure positive circulation of this belt.

Conveyor rolls 302 and 304 and the drive system for them are preferably so sized and otherwise arranged that these rolls not only have essentially identical surface speeds, but also impart to mesh belt 300 a surface speed which is slightly in excess of the average speed of advance of cover board structure material strip 216. This will cause at least slight separations or spacings to occur between successive cover board structures 298 as these structures are picked up by belt 300 following the severance from strip 216. For this purpose sprocket wheel 310 may be made slightly smaller than sprocket wheel 314.

Supported upon sideplates 20 and 22 above the midlength region of mesh belt 300 is a hood 322 within which there is mounted spray equipment for applying flexible, air-drying coating materials such as lacquers in fluid form to successive cover board structures 298. This equipment, which is of a commercially available nature, includes a main feedpipe 324, a plurality of downwardly directed spray heads 328 on each pipe 326, these spray heads being altogether in a comprehensive pattern across the path of travel of the cover board structures. A drip pan 330 is supported between the upper and lower runs of belt 300, for substantially the full length of hood 322, and extends transversely for substantially the full width of the hood between sideplates 20 and 22. Drain pipe 332 leads away from the drip pan through sideplate 20. Not shown are heating means and thermal insulation which may be associated with the spraying equipment and drip pan, particularly to prevent any undue thickening, congealing or freezing of coating material within the orifices of spray heads 328 or on pan 330 and in its drainpipe.

In the course of operation of the apparatus just described air-drying coating material such as lacquer is supplied under pressure in fluid form to main feedpipe 324 by pumping means not shown. From the main feedpipe the fluid-coating material flows outwardly through branch pipes 326 and then downwardly in atomized form from spray heads 328. The upwardly facing surfaces of successive cover board structures 298 passing below the spray heads on mesh belt 300 become coated with this material, and to a considerable extent so do the edges surfaces of these structures also. Fluid spray material which does not adhere to any cover board structure and passes through the upper run of mesh belt 300 or down around its edges is caught in drip pan 330, and maintained in a suitably warm and fluid condition, is withdrawn through drainpipe 332 for return to the pumping means.

After each partly coated cover board structure 334 passes out from under hood 322 at the right side thereof, it continues to be conveyed in the open air on mesh belt 300 while the coating material on it dries, cools, and sets. The time of open-air exposure on the belt and the distance from the right-hand side of hood 322 to the right-hand end on the belt, that is, to conveyor roll 304. This time must be sufficient for full setting of the coating material present on the cover board structure so that, for reasons made apparent hereinafter, there is no residual wetness or tackiness in this material to cause sticking between any two partly coated cover board structures 334 when one is placed on top of the other.

The spraying and air-drying operation as so far described provides a coating of flexible material such as lacquer on not

only the exposed plane surfaces and outer edge surfaces of the multilayer leaf board and spine board assemblies of successive cover board structures 298, but also the upwardly oriented surfaces of their regions or areas of hinge material left clear on either side of the spine board assemblies between these assemblies and the leaf board assemblies. Likewise there is adherence of the lacquer material to the inner edge surfaces of the upper layers of the leaf board and spine board assemblies of each structure 298 adjacent its clear regions of hinge material.

As each partly coated cover board structure 334 is run off the right-hand end of mesh belt 300 it passes over vertical plate or baffle 336 extending transversely between sideplates 20 and 22. Rightward movement of each structure 334 is stopped by the structure's striking against transverse baffle or buffer plate 338 which is set on floor 26 in suitably spaced parallel relation to baffle 336. Upon the movement of successive partly coated cover board structures being so stopped, these structures fall one after another onto and become parts of a stack 340 of such structures resting upon platform or pedestal 342. This platform may be of a vertically movable, upwardly spring-loaded kind such that the first partly coated cover board structure 334 falling onto it has only a short drop, the platform being depressed slightly each time a cover board structure is added to stack 340. There must be no wetness or tackiness of the lacquer or other sprayed coating material on the structures constituting this stack so that there will be no difficulty in removing individual structures from the stack later on without the marring of the surfaces of their coating material.

Upon the space between baffles 336 and 338 becoming substantially filled, the accumulated stack 340 of partly coated cover board structures 334 is removed, and production of such structures continued until the rolls of leaf board material 36, 38, 50 and 52, the rolls of spine board material 40 and 54, and the roll of hinge material 48 are exhausted. Desirably, all of these rolls become exhausted at about the same time for a given production run. Thereafter, with blade assembly 266 raised and motor 278 deenergized, motor 218 is operated to provide continued operation of mesh belt 300. Partly coated cover board structures 334 are turned over to expose their noncoated surfaces upwardly, and then are pushed across cutting block assembly 266 to bring them onto belt 300 for a second conveyance below spray heads 328 and the completion of their coating or encapsulation with lacquer or other suitable material which may be readily sprayed and air-dried.

Fully coated cover board structures 344 are gathered between baffles 336 and 338. A representative one of such fully coated cover board structures is shown isometrically in FIG. 9. If more convenient, of course, and assuming the availability of the necessary equipment, application of the second or completion layer of lacquer or other suitable air-drying coating material to the partly coated cover board structures 334 may be effected in a separate spray chamber, not shown. Availability of such equipment allows the illustrated apparatus to operate continuously to produce partly coated cover board structures except for times needed to load it with fresh rolls of hinge material and leaf board and spine board material.

The structure shown in FIG. 9 has the general appearance of a ring binder cover board structure awaiting attachment of its ring binder mechanism. This appearance is, however, representative only, and it is to be understood that within the contemplation of the present invention the fully coated cover board structure 344 could as well be for any other appropriate use such as use as a catalog or album structure.

Referring finally to FIG. 10, successive uncoated cover board structures 298 carried along on an endless belt 346 from the outlet side of a cover board structure material strip-severing apparatus, not shown, are passed below a tank or hopper 348 filled from a source, not shown, with thermosetting plastic material such as polyethylene, polypropylene, or polyvinylidene chloride latex in hot fluid form. This tank

has a slitlike outlet opening, provided with gating or flow-control means not shown, extending transversely to the direction of travel of cover board structures 298 for essentially the full width of a cover board structure. A sheetlike or curtainlike stream of plastic material issuing from this opening provides coatings on the upwardly oriented sides and to a substantial extent on the edge surfaces of the cover board structures passing below the opening.

Just beyond the right-hand end of endless belt 346 where it passes around conveyor roll 350 there is a drip trough 352 from which a drainpipe 354 leads away. This trough is essentially centered below the outlet opening of tank 348, and extends at least slightly beyond it at either end normally to the direction of travel of the cover board structures. Fluid material streaming down from tank 348 which does not adhere to any cover board structure is caught in the drip trough and, maintained in a suitably warm and fluid condition by means not shown, is withdrawn through drainpipe 354 for return to the tank or hopper. Suitable warming means is, of course, provided for tank 348 to maintain its plastic material contents in free flowing condition.

After crossing drip trough 352, successive partly coated cover board structures 334 are picked up on and carried farther to the right by endless belt 356 running on conveyor rolls 358 and 360. From this belt the cover board structures with their partial vinyl or other plastic coatings fully set, after adequate conveyance time on the belt for cooling, are ejected and stacked between transverse baffles 362 and 364, coming to rest on platform 366 in a manner as described already in connection with FIG. 2. It will be clear to those skilled in the pertinent art that drive for conveyor rolls 358 and 360 as well as for conveyor roll 350 may be arranged to come from a single power source such as electric motor 218, wherefrom all operating equipment of the apparatus of the present invention is powered except for the cover board structure material strip-severing apparatus, that is, blade assembly 266.

After an adequate number of partly coated cover board structures have been produced, the apparatus for manufacturing them is shut down except for endless belts 346 and 356 and the circulating system for hot fluid plastic material. The structures 334 on hand are then turned over to expose their noncoated surfaces upwardly, and placed successively on belt 346 for conveyance below the outlet opening of tank 348 and through the stream of vinyl or other fluid plastic material issuing therefrom to thereby complete the coating operation. The streaming equipment shown in FIG. 10 for applying thermosetting plastic-coating material to successive cover board structures is of a commercially available nature, and is known generally as "curtain-coating" equipment.

Protection by Letters Patent of this invention in all its aspects as the same are defined in the appended claims is sought to the greatest extent that the prior art allows.

What is claimed is:

1. An apparatus for making book cover board structures, said apparatus comprising (1) at least one pair of press rolls adapted to be fed with (i) four continuous streams of leaf board material running in parallel pairs of upper and lower streams to form upper and lower layers of successive individual leaf board assemblies with these pairs being in spaced relation to each other between adjacent edge regions and with the facing surfaces of the streams of each pair of streams being previously coated with adhesive material, and (ii) a continuous stream of hinge material running parallel to and extending laterally at least part way between the upper and lower streams of each pair of streams of leaf board material; (2) at least another pair of press rolls in spaced relation to said one pair of press rolls in spaced relation to said one pair of press rolls and adapted to be fed therefrom with said streams of leaf board material and hinge material in adhesively bonded condition and further with two continuous streams of spine board material running as a pair in essentially equally spaced relation between the pairs of streams of leaf board material and parallel to the same, one spine board stream running above and the

other spine board stream running below the stream of hinge material, and the surface of each stream of spine board material facing the stream of hinge material being previously coated with adhesive material, and (3) blade means in spaced relation to said other pair of press rolls and adapted to be fed therefrom with said streams of leaf board material, hinge material, and spine board material in adhesively bonded condition as a stream of book cover board structure material, and to sever this stream into successive individual book cover board structures.

2. An apparatus for making book cover board structures according to claim 1, said apparatus further comprising a pair of glue rolls associated with each of said streams of leaf board and spine board material over which said streams respectively pass prior to entry between any press rolls and whereby the facing surfaces of said streams are coated with adhesive material.

3. An apparatus for making book cover board structures according to claim 2, said apparatus further comprising single-power drive means for said press rolls pairs and glue roll pairs whereby all of the press rolls and glue rolls may be driven at essentially the same surface speed.

4. An apparatus for making and coating book cover board structures, said apparatus comprising (1) at least one pair of press rolls adapted to be fed with (i) four continuous streams of leaf board material running in parallel pairs of upper and lower streams to form upper and lower layers of successive individual leaf board assemblies with these pairs being in spaced relation to each other between adjacent edge regions, and (ii) a continuous stream of hinge material running parallel to and extending laterally at least part way between the upper and lower streams of each pair of streams of leaf board material; (2) a pair of glue rolls associated with each of said streams of leaf board material over which said streams respectively pass prior to entry between the rolls of said one pair of press rolls whereby the facing surfaces of said streams are coated with adhesive material; (3) at least another pair of press rolls in spaced relation to said one pair of press rolls and adapted to be fed therefrom with said streams of leaf board material and hinge material in adhesively bonded condition and further with two continuous streams of spine board material running as a pair in essentially equally spaced relation between the pairs of streams of leaf board material and parallel thereto, one spine board stream running above and the other spine board stream running below the stream of hinge material; (4) a pair of glue rolls associated with each of said streams of spine board material over which said streams respectively pass prior to entry between the rolls of said other pair of press rolls whereby the facing surfaces of said streams are coated with adhesive material; (5) blade means in spaced relation to said other pair of press rolls and adapted to be fed therefrom with said streams of leaf board material, hinge material, and spine board material in adhesively bonded condition as a stream of book cover board structure material, and to sever this stream into successive individual book cover board structures; (6) conveyor means in adjacent relation to said blade means and adapted to pick up successive individual book cover board structures therefrom and carry along these structures in linear array toward an ultimate discharge region; (7) coating means in overset relation to said conveyor means whereunder said conveyor means carries along said book cover board structures and which is adapted to apply coating material in fluid form to at least the upwardly oriented surfaces of successive structures, and (8) drive means for said press roll pairs and said glue roll pairs and for said conveyor means.

5. An apparatus for making and coating book cover board structures according to claim 4 in which said coating means oversetting said conveyor means comprises a spray chamber.

6. An apparatus for making and coating book cover board structures according to claim 4 in which said coating means oversetting said conveyor means comprises a tank with an outlet opening extending transversely to the direction of travel of book cover board structures on said conveyor means for substantially the full width of such structures.

7. An apparatus for making and coating book cover board structures according to claim 4 said apparatus further comprising independent drive means for said blade means.

8. An apparatus for making and coating book cover board structures according to claim 9, said apparatus further comprising stacking means for at least partly coated structures at said ultimate discharge region.

9. A method for making book cover board structures, said method comprising the steps of (1) generating two pairs of superposed upper and lower streams of leaf board material and feeding these pairs of streams continuously in spaced and essentially parallel coplanar relation; (2) applying adhesive material onto the facing surfaces of the streams of each pair of streams of leaf board material; (3) generating a stream of hinge material and feeding this stream continuously in essentially parallel relation to the streams of leaf board material and with its lateral edge regions extending at least part way in between the upper and lower streams of each pair of streams of leaf board material; (4) generating a pair of superposed upper and lower streams of spine board material and feeding this pair of streams continuously between the pairs of streams of leaf board material in essentially parallel relation thereto with the upper stream of spine board material running above the stream of hinge material and the lower stream of spine board material running below the stream of hinge material; (5) applying adhesive material onto the surfaces of the streams of spine board material facing each other above and below the stream of hinge material; (6) pressing the facing and adhesively coated surfaces of the streams of leaf board and spine board material together with each other and with the stream of hinge material to generate a continuous stream of bonded book cover board structure material, and (7) severing this stream into successive individual book cover board structures.

10. A method for making book cover board structures, said method comprising the steps of (1) generating two pairs of superposed upper and lower streams of leaf board material and feeding these pairs of streams continuously in spaced and essentially parallel coplanar relation; (2) applying adhesive material onto the facing surfaces of the streams of each pair of streams of leaf board material; (3) generating a stream of hinge material and feeding this stream continuously in essentially parallel relation to the streams of leaf board material and with its lateral edge regions extending at least part way in between the upper and lower streams of each pair of streams of leaf board material; (4) pressing the facing and adhesively coated surfaces of the streams of leaf board material together with each other and with the lateral edge regions of the stream of hinge material to generate a continuous, bonded stream of the leaf board streams and the hinge material stream; (5) generating a pair of superposed upper and lower streams of spine board material and feeding this pair of streams continuously between the pairs of streams of leaf board material in essentially parallel relation thereto with the upper stream of spine board material running above the stream of hinge material and the lower stream of spine board material running below the stream of hinge material; (6) applying adhesive material onto the surfaces of the streams of hinge material; (7) pressing the facing and adhesively coated surfaces of the streams of spine board material together with the upper and lower surfaces of the stream of hinge material between the streams of leaf board material to generate a continuous stream of bonded book cover board structure material, and (8) severing this stream into successive individual book cover board structures.

11. A method for making and coating book cover board

structures, said method comprising the steps of (1) making a succession of book cover board structures each comprising a first leaf board portion, a second leaf board portion, and a spine board portion disposed between said first and second leaf board portions and in hinged relation thereto; (2) picking up and conveying said book cover board structures in open condition and in linear array; (3) applying coating material in fluid form to one side of the book cover board structures successively as they are conveyed; (4) turning over these structures to expose their other sides and reconveying them in open condition and in linear array, and (5) applying coating material in fluid form to said other sides of the book cover board structures successively as they are reconveyed.

12. A method for making and coating book cover board structures according to claim 11 in which the steps of applying coating material in fluid form are effected by spraying.

13. A method for making and coating book cover board structures according to claim 11 in which the steps of applying coating material in fluid form are effected by curtain coating.

14. A method for making and coating book cover board structures, said method comprising the steps of (1) generating two pairs of superposed upper and lower streams of leaf board material and feeding these pairs of streams continuously in spaced and essentially parallel coplanar relation; (2) applying adhesive material onto the facing surfaces of the streams of each pair of streams of leaf board material; (3) generating a stream of hinge material and feeding this stream continuously in essentially parallel relation to the streams of leaf board material and with its lateral edge regions extending at least part way in between the upper and lower streams of each pair of streams of leaf board material; (4) generating a pair of superposed upper and lower streams of spine board material and feeding this pair of streams continuously between the pairs of streams of leaf board material in essentially parallel relation thereto with the upper stream of spine board material running above the stream of hinge material and the lower stream of spine board material running below the stream of hinge material; (5) applying adhesive material onto the surfaces of the streams of spine board material facing each other above and below the stream of hinge material; (6) pressing the facing and adhesively coated surfaces of the streams of leaf board and spine board material together with each other and with the stream of hinge material to generate a continuous stream of bonded book cover board structure material; (7) severing this stream into successive individual book cover board structures; (8) picking up these book cover board structures as severed and conveying them successively in linear array; (9) applying coating material in fluid form to one side of the book cover board structures successively as they are conveyed; (10) turning over these structures successively as they are conveyed; (10) turning over these structures to expose their other sides and reconveying them in linear array, and (11) applying coating material in fluid form to the said other sides of the book cover board structures successively as they are reconveyed.

15. A method for making and coating book cover board structures according to claim 14 in which the steps of applying coating material in fluid form are effected by spraying an air-drying lacquer onto the surfaces of successive book cover board structures.

16. A method for making and coating book cover board structures according to claim 14 in which the steps of applying coating material in fluid form are effected by streaming a curtain of hot thermosetting plastic onto the surfaces of successive book cover board structures.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,607,535 Dated September 21, 1971

Inventor(s) Edward K. Mullen, et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 57, "portions" should read -- portion -- .
Column 2, line 37, cancel "and" second occurrence. Column 5, line 5, "direction" should read -- directions -- ; line 24, "sideplates" should read -- sideplate -- . Column 6, line 19, cancel "material" second occurrence; line 39, "roll" should read -- rolls -- . Column 8, line 44, "rate" should read -- speed -- . Column 9, line 56, "edges" should read -- edge -- ; line 66 after "belt" add -- of each structure 334 depends upon the speed of the belt -- . Column 11, lines 69-70, cancel "in spaced relation to said one pair of press rolls". Column 13, line 5, "claim 9" should read -- claim 4 -- ; line 58, after "the surfaces of the streams of" insert -- spine board material facing each other above and below the stream of -- . Column 14, lines 49-51, cancel "(10) turning over these structures successively as they are conveyed;" .

Signed and sealed this 10th day of October 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents